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EFFECT OF ANTIOXIDANTS ON THIOBARBITURIC ACID REACTIVE SUBSTANCES OF MECHANICALLY DEBONED CHICKEN MEAT IRRADIATED WITH IONIZING RADIATION: COBALT-60 AND ELECTRON BEAM SOURCES

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ABSTRACT

Samples of MDCM with skin were divided into three groups: control (without antioxidants), Antioxidant 1 - A1 (0.3% Sodium Polyphosphate and Sodium Erythorbate 0.05%) and Antioxidant 2 - A2 (Rosemary Extract 0.02% and α-Tocopherol 0.01%). The three batches of samples were divided into nine groups: no antioxidant and non-irradiated (Cn/I), with antioxidant A1 and non-irradiated (A1n/I), with antioxidant A2 and non-irradiated (A2n/I) without antioxidant and irradiated in Cobalt-60 source (CCo), with antioxidant A1 irradiated in Cobalt 60 source (A1Co) with antioxidant A2 irradiated in Cobalt-60 source (A2Co) with antioxidant A1 irradiated in Electron beam (A1Eb) and with antioxidant A2 irradiated in Electron beam (A2Eb). Each 100 g sample was conditioned in a transparent, low density polyethylene oxygen permeable bag, frozen overnight at a temperature of -18 ± 1 ºC in a chamber, and irradiated in this state, maintaining the temperature low with dry ice. The samples were irradiated with a dose of 3.0 kGy, used two sources of radiation: Cobalt-60 (3.1 $kGy.h^{-1}$) and electron beam (2.9 $kGy.s^{-1}$). After this process, the samples were evaluated during the refrigeration period (2 ± 1 ºC) for 11 days for the following analysis: total psychrotrophic bacteria count, thiobarbituric acid reactive substances (TBARS). The addition of antioxidants was able to reduce lipid oxidation caused by the irradiation. There were no differences between the radiation sources used in the same parameters. The better antioxidants mixture in the TBARS reducing it was rosemary extract and α-tocopherol (A2).
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1. INTRODUCTION

The mechanically deboned chicken meat (MDCM) is widely used as raw meat products, by the good technological functionality and low cost [1].

Several studies show that this MDCM generally does not present a good product quality, which may be due to already infected carcasses, or disability of facilities and poor hygiene conditions during slaughter, and the product handling during preparation, combined with exposure meat to various sources of contamination thereby facilitating the proliferation of microorganisms [2].

Irradiation is a process that to increase the food security since it reduces the contamination to acceptable levels MDCM front of the Brazilian legislation [3]. Similar to the reactions caused by other types of processes, irradiation also promotes chemical alterations in food, including the reactive oxygen species (ROS).

The ROS also catalyze lipid auto-oxidation, which is one of the main causes of deterioration in the quality of raw or cooked meat products during refrigerated or frozen storage. The antioxidants can prevent the drop in quality induced by irradiation through some mechanisms to prevent lipid oxidation [4].

In this context, this study was developed to determine the best technological conditions that enable the use of radiation sources of Cobalt-60 (Co) and Electron beam (Eb) for processing the MDCM.

2. MATERIALS AND METHODS

2.1. Materials

Samples of MDCM with skin were taken for analysis during three visits to the same slaughterhouse and divided into three groups: control (without antioxidants), Antioxidant 1 - A1 (0.3% Sodium Polyphosphate and Sodium Erythorbate 0.05%) and Antioxidant 2 - A2 (Rosemary Extract 0.02% and α-Tocopherol 0.01%).

The three batches of samples were divided into nine groups: no antioxidant and non-irradiated (Cn/I), with antioxidant A1 and non-irradiated (A1n/I), with antioxidant A2 and non-irradiated (A2n/I) without antioxidant and irradiated in Cobalt-60 source (CCo), with antioxidant A1 irradiated in Cobalt 60 source (A1Co) with antioxidant A2 irradiated in Cobalt-60 source (A2Co) with antioxidant A1 irradiated in Electron beam (A1Eb) and with antioxidant A2 irradiated in Electron beam (A2Eb).

Each 100 g sample was conditioned in a transparent, low density polyethylene oxygen permeable bag, frozen overnight at a temperature of -18 ± 1 ºC in a chamber, and irradiated in this state, maintaining the temperature low with dry ice.

2.2. Irradiation

The samples were irradiated with a dose of 3.0 kGy, used two sources of radiation: Cobalt-60 (3.1 $kGy.h^{-1}$) and electron beam (2.9 $kGy.s^{-1}$).

After this process, the samples were evaluated during the refrigeration period (2 ± 1 ºC) for 11 days for the following analysis: total psychrotrophic bacteria count, thiobarbituric acid reactive substances (TBARS). The experiment was performed in triplicate.

A Gafchromic HD80 dosimeter was used to perform dosimetry routine for the samples that were submitted in the electron bean source and the Harwell amber Perspex 3042 Batch S dosimeter (603 nm) was used to perform the dosimetry routine on the samples submitted in the Cobalt-60 source.

2.3. Chemical Analysis

Lipid oxidation was measured as TBARS values, using a modified version of the Tarladgis *et al.* method [5], with hydroxytoluene butylate added before the MDCM sample homogenization step [6]. The analyses were done in triplicate for each sample evaluated.

2.4 Microbiological analysis

The psychrotrophic bacteria count was done through "Plate Count Agar" [7].

3. RESULTS AND DISCUSSION

3.1. Chemical analysis

According to figure 1, the results of lipid oxidation indicated a protective effect of antioxidant mixture of rosemary and α-tocopherol (A2) in the samples of MDCM irradiated with cobalt and electron bean sources.

Samples A2Co and A2Ab showed the best average when compared to the other samples, respectively 3.6 mg $Mal.kg^{-1}$ and 4.2 mg $Mal.kg^{-1}$. The samples nonirradiated and without antioxidant (CS / I) showed average values of 5.6 mg $Mal.kg^{-1}$, this value was above the samples and A2Co A2Ab.

The mixture of antioxidants sodium polyphosphate and sodium erythorbate (A1) was not effective in reducing lipid oxidation of the samples of MDCM irradiated, and the means for A1Co, 12.2 mg $Mal.kg^{-1}$ and AeA1, 10.8 mg $Mal.kg^{-1}$.

Several Researchers have reported success in using a combination of differents types of antioxidants to prevent lipid oxidation in irradiated meat [8,9,10]

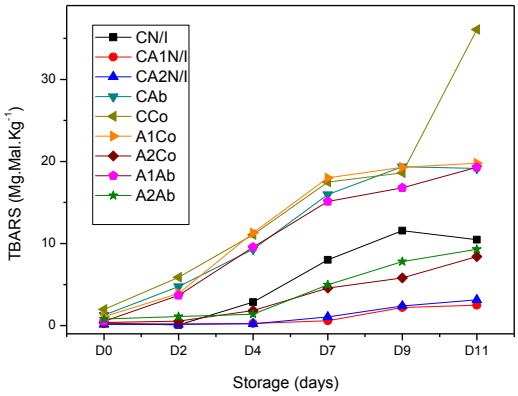

Figura 1- Average TBARS values for the MDCM samples, irradiated and nonirradiated, throughout the refrigeration storage period (2 ± 1ºC).

3.2. Microbiological analysis

Analyzing the average values of psychrotropic bacteria obtained from the samples (Figure 2) it can be seen the effect of dose of ionizing radiation on microbial count decreased until the 7th day of refrigerated storage.

After 7 days of refrigerated storage, samples A1Co, A2Co A1Ab and A2Ab showed lower psychrotrophic bacteria counts respectively 5.10, 4.35, 4.26 and 4.83 cfu / g when compared to samples CN/I, CA1N/I, CA2N/I, Cco and CAb which were mean values of re 8.12, 8.15, 8.19, 7.95 and 7.76 cfu / g, respectively.

These results show a possible aid in the process irradiation of antioxidants, contributing to an increase in the MDCM shelf-life.

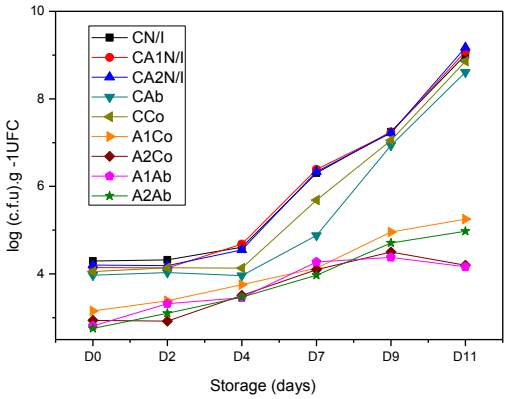

Figura 3 – Average psychrotrophic bacteria values in irradiated and nonirradiated samples over the refrigerated stored period (2 ± 1ºC).

4. CONCLUSIONS

The addition of antioxidants was able to reduce lipid oxidation caused by the irradiation and reduce the psychrotrophic bacteria values. Samples CoA2 and EbA2 showed the lowest average when compared to the other samples.There were no differences between the radiation sources used in the same parameters. The better antioxidants mixture in the TBARS reducing it was rosemary extract and α-tocopherol (A2).

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